NASA TECH BRIEF

Marshall Space Flight Center

Spectral Analysis of Multiple Time Series

In many experiments the basic measurements consist of records of two or more fluctuations that are compared to determine to what degree they are interrelated and to determine the specific nature of that relationship. The record of fluctuations is usually referred to as a time series, and there are many fields in which such sequential data are of interest. Examples include random vibrations in structures such as bridges, buildings, or aircraft; noise in electrical circuits; physiological data; economic data; fluctuation in rainfall, pressure, flow rates, temperature, and seismograms; and many other cases.

When these data are collected and presented on a graph they form a spectrum. Spectral analysis is an important method of mathematically analyzing such data.

An extensive study has been prepared which provides a more complete statistical treatment of spectral analysis of time series than has been presented elsewhere. Much of the material has never before appeared in published form. The study begins with a discussion of the fundamental ideas of the subject, and can serve as a teaching as well as a reference source.

This is followed by a discussion of stationary random processes and then covers spectral representation, linear filtering of stationary processes, complex multivariant Gaussian statistical analysis, estimation of spectral density matrices, coherence, frequency response functions, and statistical tests for stationarity.

The study also includes a description of the computer program MULTISPEC for performing spectral analysis of multiple time series.

Note:
Requests for further information may be directed to:
Technology Utilization Officer
Marshall Space Flight Center
Code A&PS-TU
Marshall Space Flight Center, Alabama 35812
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